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Methods Supplement



Developed in cooperation with:
the Network Of Employers
For Traffic Safety (NETS)

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The Network of Employers for Traffic Safety, NETS, is a non-profit organization dedicated to informing employers of the dramatic costs resulting from motor vehicle crashes. NETS assists employers to implement policies, institute on-site employee programs, and conduct community activities that focus on highway safety issues affecting employers' costs.

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| 16. Abstract This document describes how the data in <u>The Cost of Injuries to Employers: A NETS Compendium</u> were developed. It covers workplace injury incidence, workplace injury cost, and the injury costs paid by employers for injuries on-and off-the-job. Throughout, highway crash injuries receive special emphasis. Injuries cost employers \$181 billion annually, or \$1,540 per employee. These costs include injuries that occur on-the-job (work-related) and those that occur off-the-job. Almost one third (29%) of health-related fringe benefit costs paid by employers are generated by injuries to workers and their families. Overall injury accounts for 19 percent of employers' health care costs and 46 percent of their disability costs. | | | |
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This document describes how the numbers in The Cost of Injuries to Employers - a NETS Compendium were computed. It covers workplace injury incidence, workplace injury cost, and the injury costs paid by employers for injuries on and off the job. Throughout, highway crash injuries receive special emphasis. The methods sections specify the tables in the Compendium with the corresponding results.

INCIDENCE

Data about the incidence and some costs of workplace injuries are scattered through national statistical data sets. This section describes how we estimated total nonfatal workplace injuries, injuries involving medical treatment or restricted activity only, fatalities, disabling injuries, and other lost work injuries. That information appears in the first data column of Compendium Table 1. Each number has a different source and corresponding subsection heading. The numbers in the table are in boldface.

Nonfatal Injuries. By surveying the noninstitutionalized civilian population, the National Health Interview Survey (NHIS) estimates that 10.947 million nonfatal traumatic injuries occurred in the workplace in 1989 -- 18.8 percent of all traumatic injuries (National Safety Council, 1991). This estimate includes any injury resulting in contact with a medical provider or restricting activity for at least one half day.

Federal law (29 CFR 1904 and 29 USC 652) requires private firms except farms with less than 11 employees to count workplace injuries. The Bureau of Labor Statistics (BLS) surveys firms about their injury experience. BLS defines lost workday injuries as nonfatal injuries causing lost work or restricted work activity beyond the day of injury. BLS reports 3.9 lost workday injuries per 100 full-time workers in 1989 (National Safety Council, 1991). According to BLS (1990), this figure is for 76.4 million of the 117.7 million civilians working in 1989. Assuming the remaining workers have the same injury rate, 4.6 million lost work injuries occurred by BLS' definition. BLS also receives reports on less serious injuries causing loss of consciousness or medical treatment beyond first aid. BLS estimated 4.4 such injuries per 100 full-time workers, implying 5.2 million injuries nationally. Summing these two estimates yields 9.8 million worker injuries in 1989. The BLS and NHIS estimates are reasonably consistent.

Table 1 compares the two methods of estimating workplace injuries over time. The estimates from NHIS and BLS were reasonably consistent in 1987-1989. Before that, the BLS estimates were lower. Consistent with this finding, BLS (1992) states that reporting improved. The improvement followed OSHA's 1986 action instituting substantial fines (some exceeding \$2 million) for incomplete record-keeping (Smith, 1992).

Injuries Involving Medical Treatment or Restricted Activity Only. Factoring up the BLS injury estimates by severity to the NHIS total indicates 5.094 million lost workday injuries and 5.853 million other lesser injuries.

Fatal Injuries. We made or located 5 estimates of workplace fatalities. Table 2 summarizes the fatality estimates. The last row of data in the table provides data with a uniform number of homicides to facilitate comparison. The BLS estimates appear low. The Department of Labor currently is attempting to create a census of occupational fatalities. Such a system is badly needed.

- o Estimate 1 - NSC Plus Homicides. The National Safety Council's (1991, p.37) fatality estimates for 1985-1990 appear in the second column of Table 2. These estimates are

computed by breaking down the national unintentional injury fatality count from the National Center for Health Statistics by cause using vital statistics data collected annually from 37 states (National Safety Council, 1982). The state data place workplace motor vehicle deaths into the motor vehicle category. To estimate workplace motor vehicle deaths, the Council relies heavily on a special analysis of the percentage of deaths by vehicle type that were work-related in 1975. The aged distribution is particularly questionable for light trucks, which have down-sized and increasingly serve as passenger vehicles.

We added intentional deaths while working to the Council's unintentional death tally. If the homicide rate of 1.5 per 100,000 workers in California (Kraus, 1987) and Texas (Davis, 1987; Davis et al., 1987) applied nationwide, homicides would total 1,600. That count is double the National Traumatic Occupational Fatality (NTOF) surveillance system count (NIOSH, 1989). This estimate may be high. For men, Davis reports the Maryland rate is about 75 percent of the Texas rate. Therefore, we added 1,500 homicides, yielding 13,000 total deaths in 1985.

Table 1. Comparison of Workplace Injury Counts Estimated from NHIS and BLS Data (in thousands of injuries).

| <u>Year</u> | <u>NHIS</u> | <u>BLS</u> |
|-------------|-------------|------------|
| 1989 | 10,947 | 9,769 |
| 1988 | 10,057 | 9,628 |
| 1987 | 9,131 | 9,096 |
| 1986 | 10,529 | 8,508 |
| 1985 | 11,363 | 8,324 |
| 1982 | 9,542 | 7,418 |

Source: Computed from data in National Safety Council (various years) and Bureau of the Census (1991, Table 587).

Note: The standard error in the NHIS estimates is too large to allow tracking of trends in workplace injury incidence.

Table 2. Workplace Fatality Estimates.

| <u>Year</u> | <u>NSC*</u> | <u>NTOF</u> | <u>BLS</u> | <u>NHIS/NCCI</u> | <u>FARS/NSC*</u> |
|-------------------------------------|-------------|-------------|------------|------------------|------------------|
| 1990 | 10,500 | | | | 9,951 |
| 1989 | 10,700 | | | | 10,123 |
| 1988 | 11,000 | | | | 10,326 |
| 1987 | 11,300 | | | | 10,278 |
| 1986 | 11,100 | | | | 10,357 |
| 1985 | 11,500 | 9,150# | 6,181 | 7,661 | 10,402 |
| 1985 Estimates with 1,500 Homicides | | | | | |
| | 13,000 | 9,450 | 7,400 | 8,900@ | 11,900 |

* Excludes about 1,500 homicides per year.

Partially adjusted for underreporting.

@ Assuming homicide reporting comparable to BLS.

- o Estimate 2 - NTOF. The National Institute on Occupational Safety and Health's NTOF system recorded 6,400 fatalities for 1985. NTOF is largely restricted to deaths that death certificates show result from injury at work. NIOSH (1989) considers its count incomplete. The primary concern is death certificate incompleteness. A literature review in Davis et al. (1987) indicates death certificates captured 76 percent of fatal occupational injuries in Wisconsin and 67 percent in Maryland. Dividing the NTOF count by 70 percent yields an estimated 9,150 deaths.

A notable part of the NTOF undercount is workplace homicides. Louisiana, Nebraska, and Oklahoma, and New York City occupational death counts exclude homicides. Almost 10 percent of workers reside in these jurisdictions (Baker et al., 1992). Homicides at work (e.g., during robberies) are 13 percent of the NTOF total (830 deaths), while suicides are 3 percent.

New York City does not code injury at work on death certificates so few of its cases are included in NTOF. NTOF also systematically undercounts deaths more than 24 hours after injury (NIOSH, 1989) and highway crash deaths (Baker et al., 1992).

- o Estimate 3 - BLS. BLS (1987) survey data suggest 6.2 deaths per 100,000 full-time workers in firms with at least 11 employees. Multiplying this rate times 1985 employment suggests 6,792 fatalities. Of these, 611 resulted from occupational illness and 6,181 from injury. This estimate includes only 272 homicides, a clear undercount. It also appears that the industries not covered in the BLS survey generally are less safe than the industries covered. Indeed, NIOSH (1989) finds farmers and transport owner-operators -- groups omitted by BLS -- are at very high risk.
- o Estimate 4 - NHIS/NCCI. In response to a call for data by the National Council on Compensation Insurance (NCCI), Workers' Compensation insurers spread across 38 states reported 4,108,861 new Workers' Compensation claims in Policy Year 1985-86, including claims for disabling injuries, death, and medical costs only (NCCI, 1989). All these injuries were medically treated beyond first aid. Tabulating 1984-86 NHIS data shows that 89.8 percent of injuries are medically treated beyond first aid. We assume the same percentage applies to workplace injuries, meaning 10,206,000 medically treated workplace injuries occurred in 1985. Dividing 10,206,000 by 4,108,861 yields an estimate that 2.484 injuries occurred for each claim reported to NCCI. Since insurers either reported all claims or none, all types of claims should be underrepresented proportionally in the NCCI data. Multiplying 2.484 times the 3,084 fatalities reported yields an estimate of 7,661 fatal workplace injuries in 1985. Like the BLS data, the NCCI rates omit high-risk farmers and transport owner-operators. NCCI also omits self-insured firms.
- o Estimate 5 - FARS/NSC. This estimate accepts the National Safety Council's non-motor vehicle unintentional workplace death count and the homicide count of 1,500. It attempts to improve the estimate of motor vehicle deaths while working.

Miller et al. (1991) estimate that during 1984-1986, 475,000 hospitalized injuries annually resulted from motor vehicle crashes on the road. Their estimates were developed from Rice et al.'s (1989) estimate of hospitalized motor vehicle injuries by multiplying times the unpublished percentage breakdown of these injuries (96 percent involved moving motor vehicles; of these, 94.5 percent were on public roads). The Rice estimates and this breakdown were developed by multiplying Maryland Hospital Discharge Survey data on injury cause times National Hospital Discharge Survey data.

Below, we estimate 614,000 hospitalized workplace injuries annually during this same time period. According to 1983 tables that the National Safety Council obtained from BLS' Supplemental Data System (SDS), 5.3 percent of disabling injuries in 18 states resulted from motor vehicles. Multiplying 614,000 times 5.3 percent yields an estimate of 32,540 hospitalized workplace motor vehicle injuries (including injuries associated with vehicles not in transport). That is 6.85 percent of the 475,000 hospitalized crash injuries. Assume this percentage applies to fatalities.

The National Highway Traffic Safety Administration's (NHTSA, various years) Fatal Accident Reporting System annually provides a census of crash fatalities on public roads. Multiplying times 6.85 percent yields estimated workplace motor vehicle fatalities as defined by the Safety Council. The count is consistently around 3,100. Substituting this improved motor vehicle death estimate into the Safety Council estimates yields the estimates in the last column of Table 2. Adding homicides and rounding raised the total to 9,900 for 1985 and 11,600 for 1989. These FARS/NSC estimates seem the most credible. Adding the fatality estimate to the NHIS nonfatal injury estimate yields a total of 10,958,600 injuries.

Disabling Injuries. Injuries qualifying for Workers' Compensation disability payments -- or that would qualify if a worker ineligible for Workers' Compensation was eligible -- are defined as disabling injuries. Eligibility varies by State; a minimum of 2 to 9 days of lost work are required to qualify (U.S. Chamber of Commerce, various years). We estimated the number of disabling injuries in five ways. The estimates are quite consistent. As Table 3 shows, they suggest 2.3 million disabling occupational injuries annually. The NHIS data suggest the disabling injury count probably was stable through 1989. (Conversely, BLS (1987, 1991) rates indicate occupational illnesses and cumulative trauma injuries jumped from .2 million in 1985 to .4 million in 1989.)

Table 3. Disabling Workplace Injury Estimates (Thousands of Cases/Year).

| | |
|---------------------|-------|
| NHIS/NCCI | 2,271 |
| NCCI/Workers | 2,304 |
| NCCI/Benefits | 2,320 |
| Disability Payments | 2,389 |
| Medical Payments | 2,172 |
| AVERAGE | 2,291 |

- o Estimate 1 - NHIS/NCCI. The 38 states reporting all claim severities to NCCI opened 929,000 disabling injury/illness claims in policy year 1985-86. Multiplying the factor of 2.484 from the NHIS/NCCI fatality estimate times this count yields an estimate of 2.308 million disabling workplace incidents in 1985.

The NCCI's Detailed Claims Information (DCI) data base contains data on more than 450,000 randomly sampled disabling Workers' Compensation claims opened between 1979 and 1988. The sample covers 17 states. Rossman, Miller, and Douglass (1991) find that 98.37 percent of DCI disability claims are for injury. Multiplying times that percentage yields 2.27 million injuries.

- o Estimate 2 - NCCI/Workers. NCCI (1989) reports that Workers' Compensation insurers from 41 States reported 1.047 million new disabling injury and illness claims in Policy Year 1985-86. The non-responding states were CA, MN, NV, NY, ND, OH, WA, WV, and WY.

According to Bureau of the Census (1985, Table 689), these nine states included 28.2 million of the 97.5 million nonagricultural employees in the U.S. in 1985 (28.9 percent). Assuming the reporting and non-reporting states had equal claim rates per worker, 1.47 million claims were filed nationwide.

This count omits the self-insured. Nelson (1991) reports the self-insured paid 20.1 percent of the Workers' Compensation benefits payments (excluding Black Lung benefits) in 1985. Assuming they experienced a comparable proportion of the claims yields an estimate of 1.85 million disability claims.

Not all workers are covered by Workers' Compensation. If those without coverage have the same disabling injury/illness rate as those who do, total disabling incidents can be computed by multiplying the count for covered workers times the ratio of all employees to covered employees. Bureau of the Census (1991, Table 587) states that 85.1 million of the 108.1 million people were working in 1985 (78.7 percent) were covered by Workers' Compensation. That yields an estimate that 2.35 million disabling workplace injuries and illnesses occurred in 1985. Multiplying times the fraction of claims for injury yields 2.3 million disabling injuries.

- o Estimate 3 - NCCI/Benefits. This estimate uses the same approach as estimate 2. The difference is that it infers disabling injury claims in nonreporting states by assuming equal benefits payments per claim rather than equal claims per worker. Nelson (1991) reports that the nine nonreporting states paid \$6.5 billion of the \$22.2 billion in private and state government Workers' Compensation benefits in 1987 (29.4 percent). That suggests 1.48 million claims were filed nationwide, and disabling injuries totalled 2.3 million..
- o Estimate 4 - Disability Payments. According to Nelson (1991), 1986 disability payments in Workers' Compensation (excluding Black Lung benefits) totalled \$13.608 billion. According to NCCI (1989), the payments and reserves per disability case in Workers' Compensation averaged \$7,119. This estimate is for claims made in Policy Year 1985-86. Although it sums undiscounted dollars across years and includes estimates of reserves for payments in future years, we treated this estimate as a 1986-dollar estimate. If the number of injury claims is relatively stable, total disability payments in a given year will approximate the present value of current and future payments to those injured during the year. Assuming that it does, the number of claims paid equals \$13.608 billion divided by \$7,119, or 1.9 million. Dividing by the 78.7 percent of workers covered by Workers' Compensation yields an estimate of 2.43 million disabling injuries and illnesses in 1985. Removing illnesses leaves 2.4 million injuries.

This estimate and the next one are sensitive to what year's claims payment total is used. Using 1987 would imply 2.65 million injuries, and using 1988 would imply 2.98 million. The first two estimates, being more stable, are more credible.

- o Estimate 5 - Medical Payments. Nelson (1991) states that 1986 Workers' Compensation medical and hospital payments (excluding Black Lung benefits) totalled \$8.534 billion. This total includes medical payments for fatal injuries, disabling injuries, and injuries where only medical costs were compensated. NCCI (1989) indicates payments averaged \$8,895 per fatality, \$4,128 per disabling injury, and \$204 per medically treated non-disabling injury. Earlier, we estimated that 10,206,000 workplace injuries were medically treated in 1985.

Let x = the number of disabling injuries/illnesses
 a = the fraction of workers (and by assumption disabilities) covered by Workers' Compensation in 1985 = .787.

Subtracting the cost of fatalities, we have:
 $\$8.534 \text{ billion}/a - \$8,895 \times 9,800 = \$204 \times (10,206,000 - x) + \$4128 \times x$

Solving for x , an estimated 2.2 million disabling workplace illnesses and injuries occurred in 1985. Removing illnesses, injuries totalled 2.17 million.

Other Lost Workday Injuries. Subtracting the 2.291 million disabling injuries from the 5.094 million lost workday injuries yields **2.803 million other lost workday injuries.**

Hospitalized Injuries. One possible inconsistency results from these estimates. NHIS data for 1985 (National Safety Council, various years) indicate that workplace injuries were 18.2 percent of all injuries. (The average of 17.2 percent from 1985 to 1989 may be more accurate.) Multiplying 18.2 percent times the 2.347 million hospitalized injuries reported by Rice et al. (1989) for 1985 yields an estimate of **426,000 hospitalized workplace injuries.**

The DCI data fail to clearly indicate if injury resulted in hospitalization. Tabulating the data reveals that hospital lengths of stay are recorded for 24.6 percent of disabling injury claims. Another 2.2 percent of claims do not indicate a length of hospital stay but have hospital charges (including emergency room) exceeding \$1000 (in 1985 dollars). By comparison, the average daily hospital charge in 1985 was \$465, so these claimants quite probably were hospitalized.

Multiplying the 26.8 percent hospitalization rate (24.6% + 2.2%) times the disabling injury count yields an estimate of **614,000 hospitalized workplace injuries.** We believe the discrepant counts result from Rice's focus on medically defined traumatic injuries, ones with International Classification of Diseases (ICD) codes between 800 and 999. For example, their definition excluded 321,615 hospitalizations due to ICD 722.1, displacement of thoracic or lumbar intervertebral disc with myelopathy. Of these discharges, almost 84,000 probably were Workers' Compensation claims (Lemrow et al., 1990, data from Hospital Cost and Utilization Program about compensation by other government programs, expanded to national estimates). It also excluded hernia-groin (ICD 550.9), with 281,538 discharges including about 27,000 Workers' Compensation claims (Lemrow, 1990). Workers' Compensation codes these ICDs as traumatic injuries. Including workers not covered by Workers' Compensation, these two ICD codes account for 141,000 of the 188,000 hospitalizations missing from the Rice estimate.

We tabulated California hospital discharge data to probe hospitalization further. In 1990, 60 percent of the 30,153 hospital discharges paid by Workers' Compensation in California were assigned primary ICDs below the "injury" code range from 800 to 999. Fifteen percent were coded as ICD 722.1. Another 27.5 percent were coded in the 700 series. This series ostensibly represents non-traumatic musculoskeletal disorder. Yet, Workers' Compensation judged the cases as traceable to work. This may indicate a pervasive, possibly reimbursement-system induced problem with injury designation in the U.S. At a minimum, it supports a hospitalized injury estimate higher than the estimate derived from ICDs 800 and above only.

It also was possible to estimate the Workers' Compensation hospital rate for California as a check. First, we reduced the hospitalization count to reflect readmissions by applying the 12 percent readmission estimate Rice et al. made from elective admission in Maryland. Next, we estimated the number of disabling injury claims by multiplying 1989 California claims (430,790 according to National Safety Council, 1991) times the percentage of claims qualifying as disabling

in 37 other states and the District of Columbia (22.6 percent according to NCCI, 1989). Dividing the resulting 97,425 injuries into the hospitalized injury count yields a 27 percent hospitalization rate for disabling injuries, quite close to the rate recorded by NCCI.

Across all workplace injuries, our estimate represents a hospitalized injury rate of 5.4 percent. If anything, this estimate may be low. A large 1989 survey (Hensler et al., 1991, Table 3.13) found 7 percent of workplace injuries treated immediately after injury resulted in hospital admission. The survey essentially used the NHIS definition of injury. Multiplying times the 89.82 percent of injuries medically treated yields an overall hospitalization rate of 6.3 percent.

As a further validation, we examined the 6.5 percent sample of 1986 hospital discharges analyzed by Lemrow et al. (1990). These data suggest 1.035 million hospitalizations (including readmissions) were compensated by government programs other than Medicare and Medicaid. The dominant payer would be Workers' Compensation, perhaps followed by the Indian Health Service, Maternal and Child Health, and Migrant Health programs. Thus, 614,000 work hospitalizations annually, including 483,000 (78.7 percent) covered by Workers' Compensation, is credible.

Other Disabling Injuries. Subtracting the 614,000 hospitalized injuries from the 2,291,000 disabling injuries yields an estimated **1,677,000 other disabling injuries**.

Workplace Injuries in Motor Vehicle Crashes (Compendium Table 1, second data column)

We estimated workplace injuries in highway crashes using the same severity groups as for all injuries. Our estimate for fatalities is explained as part of the FARS/NSC fatality estimating procedure above. Hospitalized injuries were computed by multiplying the 32,540 hospitalized motor vehicle injuries from the FARS/NSC estimate times 96 percent in moving motor vehicles from Rice et al. (1989), yielding **31,000 hospitalized injuries**. To estimate total workplace crash injuries, we assumed that Rice et al. (1989) estimate that 9.8 percent of crash injuries were hospitalized applied to crash injuries while working. (Consistent with Rice's estimate, 1982-85 data from NHTSA's National Accident Sampling System -- NASS -- show 10.25 percent of injuries in police-reported crashes are hospitalized.) The NASS data show 53 percent of crash injuries to workers cause lost workdays. We assumed the same percentage applied to crash injuries while working. Assuming the DCI estimate that 26.8 percent of disabling injuries were hospitalized applied yielded the breakdown between disabling injuries and other lost work injuries. Notably, this procedure assumes people at work experience 6.6 percent of crash injuries in each severity category.

We checked the number of non-disabling injuries using SDS data. According to 1983 tables the National Safety Council obtained from BLS, 8 states and the Virgin Islands' reported 3.5 percent of disabling and medically treated injuries resulted from motor vehicles. Multiplying times total injuries, then subtracting the disabling injury count times 5.3 percent (the 18-state SDS estimate of disabling injuries resulting from motor vehicles), yields an estimate of 216,000 non-disabling worker crash injuries (2.8 percent of worker injuries of this severity). Our primary estimate was 201,000. The estimates are reassuringly close.

The tables count total crash injuries on the job. To get workplace crash injuries on public roads for comparison with published crash counts from all causes, we multiplied times .945, the Maryland percentage of hospitalized injuries that occur on public roads. The all-causes off-road injury counts are 2,750 deaths, 27,500 hospitalizations, 84,500 other disabling injuries, 37,500 other lost day injuries, and 133,000 injuries involving only medical treatment or restricted activity.

The workplace counts exclude injuries to other people involved in crashes with vehicles on work trips.

Non-work crash injury counts were computed by subtracting workplace counts from the totals in Rice et al. (1989). That source also gives the injury age distribution. We assumed the distribution of non-hospitalized crash injuries among severity categories mirrored the distribution for workplace crashes. To compute injury rates, we used vehicle counts and vehicle miles of travel from Motor Vehicle Manufacturers' Association (1991).

Crashes During Work (Compendium page 2)

We assumed the probability of a crash-involved vehicle being on a work trip equalled the probability of a crash injury being work-related: .0658. Estimated crash-involved vehicles on work trips are simply .0658 times the crash-involved vehicle counts in Miller et al. (1991).

Work-related crash counts are more complex. NASS indicates an injury crash involves 1.55 vehicles on average (Miller et al., 1991). The probability of a crash involving a vehicle on a work trip is $.0658 * 1.55 - .55 * .0658 * .0658 = .100$. The second term in this equation prevents double-counting when both vehicles in the crash are on work-trips. Similarly, NASS indicates a property damage only (PDO) crash involves 1.72 vehicles on average, meaning the probability of a PDO crash involving a vehicle on a work trip is .110. Multiplying these probabilities times the national crash count estimates in Miller et al. (1991) yields counts of work crashes.

Distribution of Non-work Injuries (used for computations in Compendium Tables 2 and 3, as explained in the Compendium, and for cost computations)

We calculated the number of non-work fatalities and hospitalized non-work injuries by subtracting the worker injury counts from the totals in Rice et al. (1989). In the hospitalized computation, we used the 426,000 workplace injuries in ICDs 800-999 rather than the 614,000 according to Workers' Compensation definitions.

Rice et al. (1989) shows the distribution of injuries by age group. We assumed the percentage distribution of nonfatal non-work injuries causing lost wage or house work (or equivalent functional capacity losses for those under 16) was proportional to the distribution for workplace injuries. Since hospitalized cases are known, this determines the remaining counts. The count of injuries involving medical treatment only is the total from Rice et al. minus the injury counts in other categories. For simplicity, we assumed everyone under age 65 was a worker or a worker's dependent, but no one over 65 was in either of these categories. (This assumption reduces the non-work injury rate for people aged 15-64.) Estimated non-work, non-crash injuries to those under 65 are 61,700 deaths, 960,000 hospitalizations, 2.6 million other disabling injuries, 4.4 million other lost day injuries, and 29.1 million injuries involving only medical treatment or restricted activity.

COSTS OF ON-THE-JOB HIGHWAY CRASHES (Compendium Table 4)

To compute these costs, we broke the crash costs in Miller et al. (1991) down into the cost categories used in our work injury incidence estimates. The costs for deaths and hospitalized injuries come directly from Miller et al. (1991). For disabling nonhospitalized injury, we used the costs for medically treated nonhospitalized crash injuries. For the remaining injuries, we assigned injuries with lost work the average medical treatment, emergency services, travel delay, and property damage costs per case for medically treated injuries, then allocated the remaining costs in these categories to the injuries without work loss. We assigned all productivity losses to the lost-work injuries. Legal and administrative costs were allocated proportionate to the medical and productivity costs. We arbitrarily assigned all the lost quality of life associated with medically

treated injuries and a quarter of the loss for untreated injuries to the lost-work cases, with the remainder assigned to the cases without work loss. Importantly, these allocations preserve Miller et al.'s total crash costs. They also assign a higher quality of life loss per nonfatal injury to crash injuries than other injuries. In part, this mirrors the greater severity of crash injuries. To the extent that it results from comparing carefully estimated crash costs with a quick-and-dirty, conservative estimate of workplace injury costs, however, it overestimates crash injury's importance.

Multiplying workplace incidence times the unit costs yielded the on-the-job costs. Aggregate commercial insurance overhead and profit came from Wish (1991). The costs per crash of temporary replacement transportation came from Andrews (1991).

COSTS OF WORKPLACE INJURIES (Compendium Table 5)

The categories of workplace injury costs are:

- o Medical and emergency services
- o Wage work
- o Household work
- o Legal and administrative
- o Workplace disruption
- o Quality of life
- o Motor vehicle liability insurance
- o Insurance overhead and profit

We costed property damage only for motor vehicle crashes. Property damage results from mishaps that only sometimes produce injuries. They are not injury costs.

This section describes the injury costs calculations. Because administrative costs for insurance are a percentage of claims costs, the estimating procedures examine compensation sources. The focus on payment sources also facilitates the subsequent task of estimating costs to employers. After each heading, the parenthetical notation refers to the full description of the cost category in the Compendium. The headings here correspond to those used in Compendium Table 5.

All costs are in December 1990 dollars. Table 4 lists the inflators used to inflate each cost category.

Table 4. Inflators Used by Cost Category.

| <u>Category</u> | <u>Inflator</u> |
|--------------------|--|
| Medical | Consumer Price Index - Medical |
| Emergency Services | Consumer Price Index - All Items |
| Wage/House Work | Private Nonsupervisory Hourly Earnings |
| Legal & Admin | Consumer Price Index - All Items |
| Work Disruption | Private Nonsupervisory Hourly Earnings |
| Quality of Life | Private Nonsupervisory Hourly Earnings |
| Insurance | Consumer Price Index - All Items |

Note: Values for all inflators are from the Economic Report of the President (annual).

Medical and Emergency Services (Medical Payments, Tax Payments to Cover Government Costs)

The medical and ancillary costs for injuries covered by Workers' Compensation are published annually (e.g., Nelson, 1991). Workers' Compensation fully covers medical costs, but may disallow costs for treatments lacking proven effectiveness (e.g., herbal therapy, holistic medicine, chiropractic treatment for some back injuries). Consistent with our assumption that worker injury rates do not vary with Workers' Compensation coverage, we assumed the medical costs per worker injured do not vary. Thus, total medical costs equal covered costs divided by the percentage covered -- 81 percent (Bureau of the Census, 1991, Table 587). This computation assumes that costs are stable over time.

The published costs are prevalence costs -- all costs incurred during the year, regardless of when injuries occurred. Our real interest, however, is incidence costs, the lifetime costs of injuries that occurred during the year. The costs per case not covered by Workers' Compensation were estimated from average incidence-based costs per case in NCCI (1989). Had we used those costs throughout, the cost covered by Workers' Compensation would be \$891 million lower. The difference either results from faster growth in Workers' Compensation medical costs than medical inflation or an increasing number of claims.

Weighting coverage levels by employment status with the employment status distribution (Bureau of the Census, 1991, Tables 155 and 649) yields an estimate that employers supply health insurance to 82.6 percent of employees. Assuming comparable premiums per person for all private insurance and applying the percentage of private coverage not provided by employers to household premiums (Bureau of the Census, 1991, Tables 143 and 154) yields an estimate that employers pay 93 percent of premiums for policies they provide.

Emergency services costs for motor vehicle crashes came from Miller et al. (1991). For other injuries, ambulance transport costs were computed by multiplying transport costs per case from Rice et al. (1989) times the 1989 NHIS count of injuries at work (National Safety Council, 1991). Transport cost was arbitrarily multiplied times 1.5 to account for police and fire costs. These costs have been estimated accurately only for highway crashes, where they are double emergency transport costs (Miller et al., 1991). They should be much lower for other causes except fire and crime. Other tax-funded government costs subsumed in this category are Federally funded vocational rehabilitation services and Medicaid-funded attendant services. These costs are from Rice et al. (1989).

Wage Work and Household Work (Wage Replacement)

Injured individuals lose wages, fringe benefits, and household work. Lost wages were estimated in stages. Nelson (1991) provided Workers' Compensation survivor benefits and disability payments for disabling injuries and illnesses. Multiplying these times the percentage of claims for injury yields injury disability payments covered by Workers' Compensation. We assumed the NCCI (1989) cost per case applied to other disabling injuries. (Multiplying NCCI costs per case times our case counts would underestimate Workers' Compensation disability costs per Nelson by \$2.67 billion. The difference probably results primarily from rising maximum weekly payments. Since we also estimated unreplaced wages by using mid-1980s benefit levels, the unreimbursed costs may be overestimated to the extent the reimbursed costs are underestimated.)

Workers' Compensation does not fully replace lost wages. Partial replacement has three causes:

- o Compensation payments are income tax-free, so full replacement equals after-tax wages.

- o Full compensation would create incentives to malingering or behave unsafely (for a review of the moral hazard literature, see Hensler et al. 1991).
- o Permanent disability compensation is inadequate.

Rossman, Miller, and Douglass (1991) use simulations of Workers' Compensation (DeVol, 1985, 1986) and lifetime earnings to estimate the percentage of wage loss compensated for covered cases. They conclude that Workers' Compensation compensated 60.3 percent of wage loss and none of the fringe benefit loss for covered cases in the mid-1980s.

Workers' Compensation is not the only disability insurance covering workers. To support administrative cost estimation, we estimated the remainder. We assumed other disability insurance per permanently disabling injury equalled disability insurance payments per person permanently disabled in highway crashes (from Miller et al., 1991). The permanent disability rates were computed from DCI data. We estimated the life insurance payments per worker death averaged \$35,000 (in December 1990 dollars). This amount was estimated by age group, then aggregated to all people 18-64. For each age group, the average payout equals the percentage covered times the number of deaths times the average payout per death. All data came from the American Council of Life Insurance.

Sick leave also offers some compensation. Total sick leave was computed by multiplying the number of lost-work injuries times the expected reimbursement per lost-day case times the percentage reimbursed by sick leave. Hensler et al. (1991) provide the reimbursement data. They disaggregate injuries into work, motor vehicle, and other. Expected reimbursement equals reimbursed cost per injury (gross minus net loss from Table 4-12) divided by the percentage of injuries with lost work (from Table 4-11) -- \$2200 per lost-day injury. The percentage reimbursement from sick leave equals the percentage reimbursed by sick leave plus half the percentage with two reimbursement sources (generally sick leave and another source according to Hensler et al.) from Table 4-13. We added a 1-percent premium for administering sick leave

We assumed that disabling injuries that resulted in work loss, but not enough loss to qualify for Workers' Compensation, averaged two days of lost wage work. Sick leave covers 65.2 percent of workers (Bureau of the Census, 1989). We assumed it covered the same percentage of wage losses for these minor injuries. Sick leave was valued at the average nonsupervisory, private-sector wage (\$10.17 in December, 1990 according to the Economic Report of the President).

The workers absorb the residual wage losses, which are substantial.

All lost-wage injuries result in lost fringe benefits. We valued these at 20 percent of wages, the value of supplements to wages reported in the National Income Accounts (Economic Report of the President). Alternatively, we could have used Chamber of Commerce annual survey data. These data show a fringe benefit rate of 23.85 percent exclusive of payments for time not worked. Fringes paid on sick leave were included in sick leave costs. All other fringe benefit losses are absorbed by the injured.

Household work days lost were estimated to equal work days lost times 365 days per year divided by 243 work days per year. Long-term household work and wage losses were valued using the methods in Rice et al. (1989) and data from that source and Douglass et al. (1990). Each dollar of wage loss was accompanied by \$.214 in lost household production. For short-term losses, unpublished data supporting Hensler et al. (1991) suggested multiplying the household work loss duration times .9. Short-term household work loss was valued at the adult average, \$6.79/hour (in

December 1990 dollars) according to Douglass et al. (1990). The injured bear the household work losses.

Legal and Administrative (Incident Investigation and Litigation; Other Administrative Costs)

We computed administrative costs by multiplying insurance payments by source times administrative cost percentages of:

- o 8.4 percent for health insurance
- o 9 percent for life and disability insurance
- o 13 percent for Workers' Compensation
- o 12.5 percent for auto liability insurance
- o 11 percent for auto property damage insurance

The administrative cost percentages came from Bureau of the Census (1989, 1991) and Wish (1991). The Workers' Compensation administrative cost includes most legal costs. We added the legal costs for highway crashes, which we computed in costing on-the-job crashes (see below for methodology).

Workplace Disruption (Workplace Disruption and Lost Productivity)

The work disruption and employer productivity loss costs are order-of-magnitude estimates. We computed them by arbitrarily assuming:

- o A quarter of the time wasted by deaths, disabling injuries, and injuries outside of work is supervisory time.
- o A fatal injury costs 4 months of productivity (wages plus fringe benefits). Recruitment, retraining, and lost special skills are the major cost factors.
- o A disabling injury serious enough to qualify for Worker's Compensation or require hospital admission costs one month of productivity for other employees. On average, such injuries involve 41 days of work loss.
- o Other injuries outside of work cause 3 days of lost productivity if they involve work loss and 1.5 days otherwise.
- o Other injuries on the job that cause work loss cost 2 days of supervisory time and 4 days of non-supervisory time.
- o Work-related crashes without lost-work injuries cost 2 days of supervisory time and one day of non-supervisory time. This assumption is consistent with PHH FleetAmerica's unpublished data from their subscribers.
- o Other on-duty injuries without work loss cost one supervisory day and one non-supervisory day.

Quality of Life (Wage Premiums for Risk Taking)

Workers in risky jobs and industries get higher wages. Miller (1990) identifies 30 credible studies showing the amount paid. The average across these studies is \$24 (in December 1990 dollars) in wage compensation per 1 in 100,000 chance of being killed on the job during the year.

That equates to \$2.4 million per workplace fatality. The quality of life cost -- \$1.865 million per fatality -- was computed by subtracting lost after-tax wages, fringes, and household work from the wage compensation per fatality. Multiplying the 11,600 fatalities times the quality of life value gives the wage costs for fatalities.

Miller (1990) identifies 7 studies that estimate 25% to 45% of workplace risk compensation is for fatality risk, and uses the 35% midpoint. Applying that percentage to the fatality loss yields an estimate that wage compensation for risk averages \$470 per employee, \$55.35 billion in total. This could be a substantial underestimate. If we instead used values from five studies that directly examined compensating wages to avoid nonfatal injury (reviewed in Miller, Calhoun, and Arthur, 1990), wage compensation would average \$1,390 per employee.

Motor Vehicle Liability Insurance (Motor Vehicle (MV) and Other Third Party Liability)

Employer costs of liability insurance were equated to commercial liability insurance costs from Wish (1991).

Insurance Overhead and Profit (Motor Vehicle (MV) and Other Third Party Liability; Other Administrative Costs)

We computed insurance overhead and profit by multiplying insurance payments by source times overhead cost percentages. Percentage factors came from Wish (1991) and Bureau of the Census (1991) as follows:

- o 13.5 percent for health insurance
- o 5.15 percent for Workers' Compensation
- o 8.5 percent for auto liability insurance
- o 31.9 percent for commercial auto property damage insurance

Table 5 summarizes the worker injury costs by disability level and cost category. In preparing this table, we allocated emergency services costs proportionally to fatal and disabling injury incidence. Insurance overhead and profit are omitted.

EMPLOYER COSTS OF WORKPLACE INJURIES (Compendium Table 6)

Employers pay all of the Workers' Compensation, other medical, sick leave, workplace disruption, commercial motor vehicle liability insurance, and insurance overhead expenses resulting from workplace injury. In some cases, they recover these costs from third parties. Through taxes or directly, they pay the emergency services costs. The employers also bear the expected quality of life costs, paying them in advance as wage compensation for risk-taking.

Employers pay insurance administration, overhead, profit, and legal expenses associated with coverage they provide. We assumed their share of life insurance and disability costs equals the 41.7 percent of premiums that the American Council of Life Insurance reports was group insurance.

Finally, employers pay part of the Social Security disability and survivor benefits bill. We estimated the percentage of benefits paid for injury by dividing Rice et al.'s (1989) payment estimates by the total payments in Bureau of the Census (1989, Tables 572 and 578). From Bureau of the Census (1989, Table 574), employers pay 52.4 percent of the benefit premiums. To compute the employer contributions for workplace injury, we multiplied the employer contribution times the percentage of injury deaths and permanent disabilities that result from workplace injury.

Assuming comparable payments for state government and railroad retirement coverage, 97.4 percent of workers are covered. We did not estimate the administrative costs for these benefits.

Table 5. Costs of Injury On-the-Job by Severity and Cost Category (in millions of December 1990 dollars).

| <u>Cost Category</u> | <u>Fatal</u> | <u>Disabling Lost Day</u> | <u>Minor Lost Day</u> | <u>Other</u> | <u>Total</u> |
|---------------------------|--------------|-------------------------------|---------------------------|--------------|--------------|
| Medical/Emergency Service | 154 | 14,331 | 844 | 1,761 | 17,090 |
| Wage/Fringe | 6,025 | 35,050 | 551 | 0 | 41,626 |
| Household Work | 1,288 | 5,768 | 411 | 0 | 7,467 |
| Work Disruption | 115 | 5,657 | 2,573 | 1,657 | 10,002 |
| Legal & Administrative | 215 | 4,840 | 103 | 214 | 5,372 |
| Subtotal | \$7,797 | \$65,646 | \$4,482 | \$3,632 | \$81,557 |
| PER CASE (dollars) | \$672,155 | \$28,654 | \$1,599 | \$621 | \$7,443 |
| Quality of Life | 21,630 | 40,171 | 0 | 0 | 61,801 |
| Total | \$29,427 | \$105,817 | \$4,482 | \$3,632 | \$143,358 |
| PER CASE (dollars) | \$2,536,810 | \$46,188 | \$1,599 | \$621 | \$13,083 |

Note: Excludes insurance overheads. Excludes \$1 billion in work disruption caused by PDO crashes. Disabling lost day injuries are injuries that would qualify as disabling under Workers' Compensation if the worker were covered.

COSTS OF CRASHES TO EMPLOYERS (Compendium Tables 7, 8, and 9)

Some employer costs of crashes -- workers' compensation costs, commercial liability and property damage insurance, uninsured property damage, replacement transportation, Social Security premiums per death and disabling injury, legal expenses, and wage premiums to compensate lost quality of life -- equal the costs of workplace crash incidents or the employer cost per workplace injury. Several costs were estimated by multiplying estimates of costs covered by different types of insurers -- life, disability, health -- times the percentage of premiums paid by employers. The second column in Table 6 summarizes the percentages. (Workplace health care costs not covered by Workers' Compensation were split between health insurance and employer self-pay using the factors described above for all workplace injury.) Insurance administration and overhead were computed by multiplying the costs times the expense factors given above. The last two columns in Table 6 summarize the expense factors.

Sick leave was assumed to cover all short-term wage loss for off-the-job injury to the 65 percent of workers that Bureau of the Census (1989) reports have sick leave. Unpublished data supporting Miller et al. (1991) indicated the short-term wage loss.

The methods used to compute workplace disruption costs were described above. Taxes to cover emergency services were allocated to business and personal taxes according to relative total tax bills from Bureau of the Census (1991). All costs for workplace injuries were allocated to the employers' costs. The remaining employer payments were spread equally across all injuries to people under age 65 (a surrogate, as above, for employees and their dependents).

Table 6. Percentage of Premiums Paid by Employers, Administrative Cost Percentage, and Overhead/Profit Percentage by Type of Insurance.

| Type | % of Premiums Paid by Employers | % Admin. Cost | % Overhead/ Profit |
|-------------------|------------------------------------|------------------|-----------------------|
| Workers' Comp. | 100.00 | 13.0 | 4.9 |
| Health | 73.85 | 8.4 | 8.4 |
| Life & Disability | 41.68 | 9.0 | 11.9 |
| Commercial Auto | | | |
| Property Damage | 100.00 | 11.0 | 31.9 |
| Liability | 100.00 | 12.5 | 8.5 |

Source: Computed from data in Bureau of the Census (1989, 1991) and data collected from the insurance industry by Best's Review (see especially Wish, 1991).

COSTS OF OTHER INJURIES TO EMPLOYERS (Compendium Table 11)

N.B. Compendium Table 10 is from Andrews (1991).

Employer's health insurance payments for other injuries were computed in stages. First, we subtracted the payments for workplace and crash injuries from the total paid according to Rice et al. (1989). We applied the percentages in Table 6 to the remainder. Social security disability insurance, private disability and life insurance, insurance administration and overhead/profit, and workplace disruption costs were computed in the same way for crash injuries and other non-work injuries.

Sick leave was computed by multiplying the number of non-work, non-motor vehicle lost-work injuries to people aged 18-64 (computed from total incidence by age in Rice et al. (1989) and our workplace incidence estimates) times the expected reimbursement per lost-day case times the percentage reimbursed by sick leave. As with workplace injury, Hensler et al. (1991) provide the reimbursement data. Expected reimbursement equals reimbursed cost per injury (gross minus net loss from Table 4-12) divided by the percentage of injuries with lost work (from Table 4-11) -- \$798 per lost-day injury. The percentage reimbursement from sick leave again is from Table 4-13.

COSTS OF ILLNESS TO EMPLOYERS (Compendium Table 12)

Fringe benefit costs of illness to employers were computed as total illness and injury costs minus injury costs. Nelson (1991) gives Workers' Compensation costs. Health insurance costs are from Tables 143 and 856 in Bureau of the Census (1991), and disability insurance costs are from Table 580. Costs of life insurance, Social Security disability/survivors insurance, and insurance administration and overhead/profit were computed in the same way as for injury. Sick leave costs were computed as total wages (Economic Report, 1991, Table B-23) times sick leave as a percentage of wages (Bureau of the Census, 1991, Table 684). We averaged two years of data on the sick leave percentage because the estimate is quite sensitive to the last published decimal point. As always, we included 20 percent for fringe benefits and 1 percent for administration in the sick leave costs.

One reasonableness check was possible. We estimated injury accounted for 24.1 percent of sick leave costs. By comparison, Hensler et al. (1991) estimate a third of short-term work loss results from injury. Thus, if anything, we have underestimated injury's share of sick leave costs. In particular, we ignored any sick leave attributable to caregiving. Hensler et al. find time off for caregivers equals roughly 10 percent of the time lost by workers due to their own injuries.

RECOMMENDATIONS FOR FUTURE RESEARCH

Several research activities would improve the estimates here. Because the costs to employers and costs of crashes are largely derived from the overall incidence and cost of workplace injury, research on the overall picture is especially important. Specific research suggestions include:

- o Of highest priority from a cost-effectiveness viewpoint, further analysis of the data collected by Hensler et al. (1991) at the RAND Corporation. This analysis should not be just a broad charge to RAND to further analyze their data in order to yield insight into research questions of interest. Some broader analysis (e.g., of incidence-based costs) might be helpful. The primary focus, however, should be improved estimates of specific factors or cost estimates in the overall cost model. Even where needed data are in Hensler et al., they are sufficiently embedded that our extraction yields imperfect estimates. This problem is not a criticism of Hensler et al.; our use for their data differs from the report's focus.
- o Further research on workplace injury incidence seems warranted. In particular, more analysis of NCCI data, supplemented by telephone calls to states to fill in missing data, might be informative.
- o Further tabulation of NHIS and NHDS data would be helpful. In particular, multi-year NHIS data can provide better insight into the lost-day injury count, the percentage of motor vehicle injuries on the job, and possibly even the hospitalized workplace injury count. The two targets for the NHDS data analysis should be to get updated incidence counts and data on injuries outside ICD codes 800 to 999.
- o Application of data from states that mandate cause-coded (E-coded) hospital discharge data to improve Rice et al.'s estimates of injury incidence for relevant causes. These data are available and usable for CA, NY, VT, and WA. Analyzing them also may yield further insight into who pays and into long-term costs.
- o Further analysis of State hospital discharge data sets would improve estimated hospitalization rates for Workers' Compensation disabling injuries, as well as yielding insight into the nature of the admitting conditions. This appraisal should focus on selected States where the number of lost workday claims is known. A major question is how often secondary diagnoses are injury diagnoses (ICD greater than 800) when primary diagnoses are not and how often cases with primary diagnoses in the 700 ICD series appear to be rehospitalizations or old injuries.
- o Analysis of workplace disruption costs through study of stratified random samples of worker deaths, serious worker injuries, minor injuries, and PDO crashes. For deaths, we suggest 30 per major injury group, with sampling from obituaries in a cluster sample of jurisdictions. Sampling for serious injuries should be hospital-based, using the same jurisdictions. Firms should be contacted soon after the event and periodically thereafter. For minor injuries/crashes, we suggest contacting a random sample of firms in the cluster-sample areas. Data on disruption are unavailable in national data sets.
- o Estimates by industry/occupation are feasible and might be desirable.
- o More probing of the reasons why DCI costs per case are substantially lower than NCCI Insurance Expense Exhibit (NCCI, 1989) ultimate experience might lead to improved estimates. The present estimates may have blurred the line between prevalence and incidence costs.

- o Analysis of National Electronic Injury Surveillance System (NEISS) data describing workplace injury treated in the emergency room between 1982 and 1985 also might better inform the incidence and cost estimates. This analysis should tap the Urban Institute's injury cost files by NEISS injury code.
- o Tabulating National Nursing Home Survey data by ICD code would yield better information about long-term costs for serious injuries.
- o Analyzing 1987 National Medical Expenditure Survey data would improve the estimated costs of ambulance transport, prescriptions, medical devices, and other ancillary costs.
- o Adding questions identifying injury and motor vehicle injury to the National Ambulatory Medical Care Survey, the Disability Supplement to the National Health Interview Survey, and the Survey of Income and Program Participation would yield cost-effective information on medical costs, sources of payment, and long-term costs of injuries.

REFERENCES

- American Council of Life Insurance. Life Insurance Fact Book, Washington, DC, biennial.
- Andrews, T.L. "Understanding the True Cost of Accidents," in Understanding the True Costs of Accidents and the Value of a Fleet Safety Program, Hunt Valley, MD: PHH FleetAmerica, 1991.
- Baker, Susan, Brian O'Neill, Marvin Ginsburg, and Guohua Li. The Injury Fact Book, New York: Oxford University Press, 1992.
- Bureau of the Census. Statistical Abstract of the United States, Washington, DC: U.S. Government Printing Office, annual.
- BLS. Occupational Injuries and Illnesses in the United States by Industry. Washington, DC: U.S. Bureau of Labor Statistics, annual.
- Davis, Harold. "Workplace Homicides of Texas Males," American Journal Of Public Health 77(10), 1987, pp. 1290-1293.
- Davis, Harold, Patricia Honchar, and Lucina Suarez. "Fatal Occupational Injuries of Women, Texas 1975-84" American Journal Of Public Health 77(12), 1987, pp. 1524-1527.
- DeVol, Karen. Income Replacement for Short-term Disability: The Role of Workers' Compensation. Cambridge, MA: Workers' Compensation Research Institute, 1985.
- DeVol, Karen. Income Replacement for Long-term Disability. Cambridge, MA: Workers' Compensation Research Institute, 1986.
- Douglass, John B., Genevieve M. Kenney, and Ted R. Miller. "Which Estimates of Household Production Are Best?," Journal of Forensic Economics, 4:1, 1990, pp. 25-46.
- Economic Report of the President, Washington, DC: U.S. Government Printing Office, annual.
- Hensler, Deborah R., M. Susan Marquis, et al. Compensation for Accidental Injuries in the United States, Report R-3999-HHS/ICJ, Santa Monica, CA: RAND, 1991.
- Kraus, Jess F. "Homicide While at Work: Persons, Industries, and Occupations at High Risk," American Journal Of Public Health 77(10), 1987, pp. 1285-1289.
- Lemrow, Nancy, David Adams, Rosanna Coffey, and Dean Farley. The 50 Most Frequent Diagnosis-Related Groups (DRGs), Diagnoses, and Procedures: Statistics by Hospital Size and Location. Hospital Studies Program Research Note 13, Washington, DC: Agency for Health Care Policy and Research, 1990.
- Miller, Ted R. "The Plausible Range for the Value of Life: Red Herrings Among the Mackerel," Journal of Forensic Economics 3(3), 17-40, 1990.
- Miller, Ted R., Charles Calhoun, and W. Brian Arthur. "Utility-Adjusted Impairment Years: A Low-cost Approach to Morbidity Valuation," in Estimating and Valuing Morbidity in a Policy Context: Proceedings of a June 1989 AERE Workshop, EPA-230-08-89-065, U.S. Environmental Protection Agency, 1989.

Miller, Ted, John Viner, Shelli Rossman, Nancy Pindus, William Gellert, et al. The Costs of Highway Crashes, Washington, DC: The Urban Institute and Federal Highway Administration, 1991.

Motor Vehicle Manufacturers' Association. MVMA Motor Vehicle Facts and Figures '90, Washington, DC: MVMA of the United States, Inc., 1991.

NCCI (National Council on Compensation Insurance). "Insurance Expense Exhibit," Actuarial Operations Memorandum to Subscribers NCCI-89-116, Boca Raton, FL, October 24, 1989.

NHTSA (National Highway Traffic Safety Administration). Fatal Accident Reporting System, Washington, DC: NHTSA, annual.

NIOSH (National Institute for Occupational Safety and Health). National Traumatic Occupational Fatalities: 1980-1985, Morgantown, WV: NIOSH, 1989.

National Safety Council. Accident Facts, Chicago, IL, annual.

National Safety Council. Documentation of National Safety Council Statistics Department Estimating Procedures for Motor-Vehicle, Work, Home, and Public Deaths and Death Rates (mimeo), Chicago, IL, 1982.

Nelson, William J., Jr. "Workers' Compensation: Coverage, Benefits, and Costs, 1988," Social Security Bulletin 54(3), March 1991, pp. 12-20.

Rice, Dorothy P., Ellen J. MacKenzie, and Associates. Cost of Injury in the United States: A Report to Congress, San Francisco: Institute for Health and Aging, University of California, and Johns Hopkins University, 1989.

Rossman, Shelli, Ted Miller, and John Douglass. The Costs of Occupational Traumatic and Cumulative Injuries, Report to National Institute on Occupational Safety and Health, Washington, DC: The Urban Institute, 1991.

Smith, Robert. Have OSHA and Workers' Compensation Made the Workplace Safer?, Working Paper, Cornell University, 1992.

U.S. Chamber of Commerce. Analysis of Workers' Compensation Laws, Washington, DC, annual.

U.S. Chamber of Commerce. Employee Benefits, Reference Publication 0246, annual.

Wish, Paul. "Review and Preview: 1990 and 1991," Best's Review 91(9), pp. 14-24, 1991.

